a spoon or such-like article the light is readily produced, and when two such masses are rubbed together a very strong glow is the result. THOS. STEEL.

Colonial Sugar Ref. Co., Ltd., Sydney, N.S.W.

The Wanton Destruction of Rare Visitants to our Shores.

IN the *Zoologist* for this month (No. 691) is recorded the destruction and capture of the following rare bird visitants to our shores:—Six crossbills, one goshawk, one flamingo, one little bustard, one great shearwater, one avocet, and two Sclavonian grebes. Is it not time this senseless and unwarrantable destruction of these beautiful creatures ceased? Will you, as the leading scientific journal, lift up your voice against it, and earn the gratitude of every lover of nature?

Rottingdean, Sussex. E. L. J. RIDSDALE.

EXPERIMENTS ON THE AUTUMN COLOURING OF PLANTS.

THOUGH in the course of the present century a good deal has been written as to the causes of the autumn tints of leaves, our knowledge of this subject is still in a very unsatisfactory condition. The following notes may serve to show the nature of some of the principal factors involved.

While engaged on some osmotic experiments in the summer of 1897, I made the observation that the newly-formed leaves of specimens of *Hydrocharis morsus-ranae*, which had been placed some days previously in a weak solution of cane-sugar, assumed a rich reddish-brown colour, although otherwise perfectly normal. Further experiments showed that the culture of this plant in solutions of cane-sugar, grape-sugar and fructose constantly has this effect on the colouring of those leaves which are developed during the sojourn of the specimens in these solutions, and that even the leaves which were fully developed before the commencement of the experiments gradually become of the same reddish-brown hue.

This colour is due to the appearance of red cell-sap in the palisade-cells, and in the cells lining the air-chambers of the leaf. A certain number of these cells often contain red cell-sap under normal conditions, especially if the plants are strongly insolated, and the temperature of the water in which they are living is somewhat low; but under these conditions, the leaves never assume a colour approaching to that of plants cultivated in sugar solutions. If the sugar solutions are changed often enough, the plants remain perfectly healthy for weeks, and multiply rapidly by means of suckers. In one set of experiments I have followed the development during four successive generations.

In specimens of Hydrocharis grown in a good light the leaf-stalks, suckers and roots are usually more or less dotted with red under normal conditions; but the number of cells containing red cell-sap is very much increased in these parts of the plant, if the specimens are cultivated in a sugar solution, even though the conditions of light and temperature are much less favourable for the production of the red pigment than in the specimens grown in pure water.

Salt solutions and the solutions of organic compounds other than the carbohydrates have no such effect on Hydrocharis, and even among the sugars galactose is entirely without effect. Lactose acts only after a long period, and the effect is even then very slight and is probably due to hydrolysis.

A few experiments with *Lemna minor* and with *Potamogeton perfoliatus* in solutions of various sugars not leading to similar results, I should probably have laid the whole subject aside, had not my attention shortly afterwards been drawn to the red-colouring of plants in general by a tour in the Upper Engadine just at a time when the autumnal colouring of the Alpine plants was reaching its climax. There, among the magnificent tints that overspread the mountain slopes, my mind naturally reverted to my laboratory experiments and the possibility of a correlation between the two sets of phenomena suggested itself. Observations and experiments, made upon the spot, led me to the conclusion that there were good grounds for the conjecture that an increase of sugar at the cost of starch might be *one* of the factors concerned in the formation of the red pigment of those leaves which become red in autumn.

Of such leaves there are two distinct classes. The one set comprises the perennial leaves, and those leaves which, formed during the later part of the summer, remain alive till the following spring or summer. This set of leaves (with the exception of those which die in spring) lose their reddish hues with the return of warmer weather (*e.g.* holly, ivy). The other set comprises those leaves which fall and die soon after attaining their reddish tints.

Lidforss[1] has drawn attention to the fact that during the winter the leaves of our native plants are entirely devoid of starch, but contain large quantities of sugar. Without a previous knowledge of Lidforss' paper, I obtained the same results and found that the deciduous leaves at the time they assume their autumn tints contain more sugar and less starch than in midsummer.

The remarkable coincidence of the appearance of red cell-sap with the increase of sugar in autumn and its disappearance in spring at a time when the greater part of the sugar in the leaf is recondensed to starch, together with my observations on Hydrocharis, formed the starting point for a considerable number of experiments on the formation of the red pigment of leaves.

These experiments and observations have led me to conclusions which may be stated broadly thus:—

The red colouring matters of green plants are probably of the nature of glucosides, and are in most cases unions of tannin compounds with sugar.

The chief physical factors in their production are: (*a*) sunshine, which on the one hand augments assimilation and the production of sugar, and on the other hand accelerates the chemical process leading to the formation of the pigment; and (*b*) a low temperature, which prevents the conversion of the sugar into starch. In other words, the red autumnal tints are in great measure the direct result of the autumnal climatic conditions.

It is possible in many plants to produce (red) autumnal tints at any time of the year, by feeding them with glucose.

Generally speaking, this artificial production of red cell-sap is possible only where the natural reddening of the leaf has its seat in the mesophyll cells. In cases where the coloration is in the epidermis, experiments with glucose are unsuccessful.

Among plants especially favourable for experiments on the artificial production of red cell-sap, I may mention various species of *Lilium* (*L. Martagon*, *L. candidum*, *L. umbelliferum*), Holly (*Ilex aquifolium*), various succulent plants, such as *Saxifraga crassifolium*, and among water-plants, besides *Hydrocharis*, the different indigenous species of *Utricularia*.

A full account of these experiments, together with their connection with various phenomena of plant-life, will appear shortly in the *Jahrbücher für wissenschaftliche Botanik.* E. OVERTON.

THE GREAT CATALOGUE OF BIRDS.

THE recent issue of the twenty-sixth volume of the "Catalogue of Birds in the British Museum"[2] (the twenty-seventh and concluding volume having been published in advance in 1895) brings to an end a formidable task, commenced in 1874, which has occupied the time and energies of some of the leading ornithologists of the present day during the past twenty-five years. For it must be recollected that this work, although modestly entitled a "Catalogue of the Birds in the British Museum," is far more than a mere list of specimens. It gives, in fact, besides a list of the specimens in the British Museum, an account of all the known species of birds, embracing their synonyms (*i.e.* the various names which have been applied to them by different authors), descriptions of their various plumages, their countries and all other necessary information concerning them. Such a work, although it has been attempted on several occasions, has never been brought to a conclusion since Latham completed his "General History of Birds" in 1824. And in Latham's days, it should be remembered, a general history of birds was a comparatively easy matter. Latham was acquainted with only some 4300 species of birds, which he grouped in 112 genera. The British Museum Catalogue gives us an account of 11,617 species of birds, arranged in 2255 genera, showing that our knowledge of the class Aves has increased nearly three-fold since 1824.

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[1] *Botan. Centralblatt*, Bd. 68. p. 33–44 (1896).

[2] "Catalogue of the Plataleæ. Herodiones, Steganopodes, Pygopodes, Alcæ, and Impennes in the Collection of the British Museum." By R. Bowdler Sharpe and W. R. Ogilvie-Grant. (London, 1898.)

The "Catalogue of Birds" was commenced in 1874, and finished in 1898. As completed, it forms twenty-seven octavo volumes, varying in extent from 300 to 800 pages each, and illustrated by numerous coloured plates. We give a list of the authors, contents, and dates of issue.

Vol.	Contents.	Author.	Date.	No. of Genera.	No. of Species.
I.	Accipitres	R. B. Sharpe	1874	80	389
II.	Striges...	R. B. Sharpe	1875	19	190
III.	Coliomorphæ	R. B. Sharpe	1877	94	370
IV.	Cichlomorphæ, Pt. I..	R. B. Sharpe	1879	81	520
V.	Cichlomorphæ, Pt. II.	H. Seebohm	1881	18	344
VI.	Cichlomorphæ, Pt. III.	R. B. Sharpe	1881	66	407
VII.	Cichlomorphæ, Pt. IV.	R. B. Sharpe	1883	164	687
VIII.	Cichlomorphæ, Pt. V., and Certhiomorphæ	Hans Gadow	1883	46	402
IX.	Cinnyrimorphæ ...	Hans Gadow	1884	35	355
X.	Fringilliformes, Pt. I..	R. B. Sharpe	1885	63	448
XI.	Fringilliformes, Pt. II.	P. L. Sclater	1886	100	575
XII.	Fringilliformes, Pt. III.	R. B. Sharpe	1888	101	559
XIII.	Sturniformes	R. B. Sharpe	1890	129	601
XIV.	Oligomyodæ	P. L. Sclater	1888	142	665
XV.	Tracheophonæ ...	P. L. Sclater	1890	92	531
XVI.	Upupæ and Trochili.. Coraciæ	O. Salvin ... E. Hartert...	1892	163	687
XVII.	Coraciæ (*continued*) and Halcyones ... Bucerotes and Trogones	R. B. Sharpe W. R. Ogilvie Grant ...	1892	67	397
XVIII.	Scansores	E. Hargitt...	1890	50	385
XIX.	Scansores and Coccyges...	P. L. Sclater and G. E. Shelley ...	1891	87	448
XX.	Psittaci	T. Salvadori	1891	79	499
XXI.	Columbæ	T. Salvadori	1893	68	415
XXII.	Pterocletes, Gallinæ, Opisthocomi, Hemipodii	W. R. Ogilvie Grant ,...	1893	94	426
XXIII.	Fulicariæ and Alectorides	R. B. Sharpe	1894	88	252
XXIV.	Limicolæ	R. B. Sharpe	1896	102	255
XXV.	Gaviæ ... ... Tubinares	H. Saunders O. Salvin ...	1896	46	224
XXVI.	Plataleæ, Herodiones, Steganopodes, Pygopodes, Alcæ, and Impennes	R. B. Sharpe and W. R. Ogilvie Grant ...	1898	98	290
XXVII.	Chenomorphæ, Crypturi, and Ratitæ ...	T. Salvadori	1895	83	296
				2255	11,617

The Catalogue was commenced in 1872 by Dr. R. Bowdler Sharpe, soon after he had succeeded the late George Robert Gray in the charge of the national collection of birds. To the late Dr. John Edward Gray, then Keeper of the Zoological Department, must be ascribed the credit of starting it, though he only lived to see the first volume brought to completion. This was issued in 1874, and contained an account of the diurnal birds of prey; it was followed in 1875 by the second volume, also prepared by Dr. Sharpe, devoted to the owls. After this Dr. Sharpe proceeded to attack the long array of Passeres, an order which embraces rather more than half the whole number of known birds, and got out two volumes on the subject in 1877 and 1879. The late Henry Seebohm—a distinguished traveller and ornithologist—one of whose pet groups was the thrushes and their allies, was then invited by Dr. Günther, who had succeeded Dr. Gray in the keepership of the zoological department, to prepare the catalogue of this family. Seebohm produced it in 1881, after what, he tells us, was "two close years of application" to a very difficult task. Meanwhile Dr. Sharpe was working away at other groups of the great Passerinie Order, and succeeded in issuing two more volumes (vols. vi. and vii.) in 1881 and 1883. By this time, however, Dr. Günther had quite satisfied himself that if the Catalogue of Birds was to be finished within a reasonable period it would be necessary to obtain further aid from outside. The task was far too vast for the unassisted efforts of a single ornithologist, who had, moreover, the charge and arrangement of the enormous national collection of birds on his shoulders, however hard he might work. Failing to find any qualified British ornithologist with leisure to help him, Dr. Günther naturally turned to Germany, and invited the aid of Dr. Hans Gadow (now settled at Cambridge), to whom we are indebted for the compilation of vols. viii. and ix. of the "Bird-Catalogue." Dr. Günther also managed to persuade Mr. Sclater, the Secretary of the Zoological Society, who was the possessor of a very full series of American birds, not only to part with them in favour of the national collection, but also to undertake to prepare the catalogues of some of the groups that he had made the special subjects of his studies. It thus came to pass that three volumes of the catalogue of Passeres, and half of a fourth volume relating to the Scansores, were written by Mr. Sclater. The very difficult and laborious task of cataloguing the humming birds (Trochilidæ), with some 500 species, was in the meanwhile entrusted to the late Mr. Osbert Salvin, and, we need hardly say, was most efficiently performed by that accomplished and accurate naturalist. Mr. Hartert (of the Tring Museum) joined forces with Mr. Salvin, and contributed an account of the swifts and goat-suckers to the same volume, which forms the sixteenth of the series. Another expert—the late Mr. Hargitt, was employed on the catalogue of woodpeckers (vol. xviii.)—a group to which he had paid special attention, while Captain Shelley undertook the cuckoos, Count Salvadori the parrots and pigeons, and Mr. Ogilvie-Grant the game-birds—groups with which, in each case, the authors were already respectively familiar. In this way, at the end of 1893, twenty-two volumes of the Catalogue had been brought to a conclusion, and only five more remained to be accomplished. Some little difficulty, we believe, was experienced by Dr. Günther in allocating these five volumes in a satisfactory manner, but Mr. Howard Saunders, our chief authority on the Laridæ (gulls and terns), was obviously the proper person to undertake their enrolment in the national catalogue, and at the same time his most valuable private collection of these birds was secured for the Museum. Nor was it less obvious that the late Osbert Salvin was the person to whom the charge of the petrels, a very difficult group, of which he had long made a special study, should be assigned. Both these selections were most satisfactory, and the result was that vol. xxv., produced by the joint efforts of these two ornithologists in 1896, is one of the best of the long series. At the same time the veteran systematist, Count Salvadori, of Turin, undertook the final volume (xxvii.), containing the Anseres (ducks and geese), the tinamous and the ostriches;

and the three remaining volumes (xxiii., xxiv. and xxvi.) were assigned to the hard-worked officials of the British Museum. Of these Dr. Sharpe got out one in 1894, and another in 1896. The twenty-sixth volume, of which the first half was prepared by Dr. Sharpe, and the second by Mr. Grant, has now just made its appearance, and renders the long series of twenty-seven volumes complete.

Taking this laborious piece of systematic work as a whole, there can be no question, we think, of its value. This has been indeed acknowledged by naturalists all over the world, whose anxious inquiries for many years have been as to the prospects of its being brought to a conclusion. The variation in treatment of the different portions of the work, caused by the idiosyncracies of the eleven ornithologists who contributed to its composition, was of course unavoidable. No one person could have accomplished the task, and a wise discretion on minor points was left to those who helped in its composition. Some of them have made many generic divisions, others few. Some have written long descriptions, others short ones. Some have employed one set of rules of nomenclature, others have followed another code. Greater uniformity on all these points would, of course, have been very desirable. But it was practically unattainable, and its absence has scarcely diminished the usefulness of the whole series. During its progress, however, great additions have been made to our knowledge of many of the groups, especially to those treated of in the earlier volumes. From Sir William Flower's preface to the twenty-sixth volume we are pleased to learn that a supplement, containing references to every species of bird described subsequently to the publication of the volume which treats of the group to which it belongs, is in preparation, and will be accompanied by a general index. This will be a most valuable addition, and will serve to render the vast stores of ornithological lore comprised in the twenty-seven volumes of the "Great Catalogue of Birds" still more useful to future workers. Those who have planned and those who have carried out this important undertaking alike deserve the grateful thanks of all zoologists.

SIGNS OF PROGRESS IN SCIENCE TEACHING.

DURING the past Christmas vacation, London, Manchester, Shrewsbury and other places have been astir with educational conferences. These have been attended by teachers of all ranks. The College of Preceptors held a gathering which lasted a fortnight, with daily morning and afternoon sessions, including a conference of science teachers organised by the Technical Education Board of the London County Council. These conferences have dealt not only with questions of organisation, but largely with the subjects to be taught, and the methods of teaching them. The increasing interest in the movement is also indicated by the appearance of new educational journals, in addition to those that already occupy the field. One of these, *The School World*, has special reference to modes of instruction, together with articles on different departments of the subject by good writers of the advancing school. Progress is also shown by the much more general introduction of the teaching of science. The public elementary schools have mostly introduced science into their scheme of instruction, and it occupies a more and more worthy place in their time tables. All the great public schools include some amount of science in their curriculum. The universities of course have professorships of various sciences, and these are better attended by students than formerly. The intermediate schools, which are under private management, are following suit, though in very various degrees.

But what is the teaching of science? The time is past for the chemistry lesson to consist merely of the precipitation of the highly coloured chromates or iodides, and the explosion of oxygen and hydrogen; or to appear as "la chimie amusante" in the prospectus of a young ladies' school. It is perhaps generally recognised that physics and chemistry cannot be taught merely from text-books; that would be uninteresting, and scarcely instructive. Nor must the teaching depend solely upon showy demonstrations on the lecturer's table. These may be attractive, but they often leave only a confusion of ideas in the mind of the student. There is a great tendency now to recognise that the pupils should not only read descriptions of objects, but see and handle them; not only watch experiments, but perform them. There is a movement in many quarters to adopt the "Heuristic" method, so strongly advocated by Prof. Armstrong, by which the student is led to find out results or causes for himself, and to express them intelligently in writing. This is a truly educational method; but it has its limitations. One of these is the amount of time that can be given, as from the very nature of it this must be a slow process: another is that the teacher ought himself to suggest certain lines of research, and watch over the student's progress, directing him unconsciously towards the right conclusions.

In this transition period there are two practical difficulties. First, the want of teachers sufficiently imbued with the new methods to carry them out successfully. Secondly, the examination which usually forms a necessary part of the student's career. This examination is generally founded more upon the old than the new methods, and is directed to ascertaining the amount of the student's knowledge rather than the discipline which his mind has received. It is important to bear in mind what is the chief object in view; not so much to teach a specific science as to indoctrinate the student in the principles which underlie all science, and which will be of essential service to him in whatever calling he may afterwards engage: not so much to store his mind with facts, as to develop his faculties—his powers of observation and reasoning. In bringing about such a reform the practical teacher may often find it necessary to proceed, not by a sudden revolution, but by gradual modifications and improvements in method.

J. H. GLADSTONE.

PROFESSOR ALLEYNE NICHOLSON.

TO all students of zoology (in its most extended sense) the name of Alleyne Nicholson is so familiar, that the recent announcement of his premature death will probably have caused a sense of personal loss even to those who never enjoyed the pleasure of his acquaintance. By those who did know him personally, the general charm of his manner, and his enthusiasm for his favourite science, will not readily be forgotten.

Henry Alleyne Nicholson was born at Penrith, Cumberland, in the autumn of 1844; his father being Dr. John Nicholson, who gained considerable distinction as a linguist and philologist, especially in Oriental literature. The son was educated first at Appleby Grammar School, subsequently at Göttingen, and finally at the University of Edinburgh. At the latter University he gained the Baxter Natural Science Scholarship; and when only twenty-five he was appointed (in 1869) Lecturer on Natural History in the Extra-Mural School of Medicine in that city, an appointment which he held till 1871, when he became Professor of Natural History and Botany in the University of Toronto. He did not, however, remain long at the latter post, moving to Durham in the same capacity in 1874; while one year later (1875), he accepted the